UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/757,507	01/15/2004	Axel Schwotzer	66489-034-5	4613

25269 7590 10/01/2007

DYKEMA GOSSETT PLLC
FRANKLIN SQUARE, THIRD FLOOR WEST
1300 I STREET, NW
WASHINGTON, DC 20005

EXAMINER	
DALEY, CLIFTON G	
ART UNIT	**PAPER NUMBER**
2624	

MAIL DATE	DELIVERY MODE
10/01/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/757,507	SCHWOTZER, AXEL	
	Examiner	Art Unit	
	Clifton G. Daley	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *1/15/2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-14* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-14* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *15 January 2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: Fig. 5, 7. Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-4, 6 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huang et al. (Hereinafter "Huang": Peisen S. Huang, Qingying Hu, Feng Jin and

Fu-Pen Chiang, "Color-encoded fringe projection and phase shifting for 3-D surface contouring", 1998, SPIE, Vol. 3407, pp. 477-482) in view of Joenathan (C. Joenathan, "Phase-measuring interferometry: new methods and error analysis", 1994, Optical Society of America, Vol. 33, No. 19, pp. 4147-4155).

Regarding claims 1 and 14, Huang teaches a method and associated device of imaging an object for dental purposes, comprising the steps of: a) projecting a striped pattern on to the object to be imaged **(Fig. 1, Digital Projector)**, b) recording the projected striped pattern as a basic image (R.sub.i) with a picture receiver at an angle other than the angle of projection **(Fig. 1, CCD Camera)**, steps a) and b) being carried out at a number of different positions of the phase relation of the striped pattern **(page 479, § 2.2, line 1)**, and c) computing an image of said object from the plurality of basic camera images that are out-of-phase with each other (R.sub.1 . . . , R.sub.n) **(Fig. 1, 3-D image)**.

Huang does not teach the further limitations wherein in order to suppress periodic disturbances, i.e., noise, in step c), c1) forming from the basic camera (R.sub.1 . . . , R.sub.m) images at least two groups of basic images (R.sub.1, R.sub.2, . . . , R.sub.n; R.sub.2, and R.sub.3, . . . , R.sub.n+1), c2) computing a phase related image (P.sub.j) of the object to be imaged from each group of basic images (R.sub.1, R.sub.2, . . . , R.sub.n; R.sub.2, R.sub.3, . . . , R.sub.n+1) c3) averaging the computed phase related images (P.sub.1, P.sub.2) such that a phase related image (P) having a reduced

amount of noise is formed, and c4) computing an image of the object to be imaged from the phase related image (P) having a reduced amount of noise.

However, Joenathan discloses the steps of c1) forming from the basic camera (R.sub.1 . . . , R.sub.m) images at least two groups of basic images (R.sub.1, R.sub.2, . . . , R.sub.n; R.sub.2, and R.sub.3, . . . , R.sub.n+1) **(page 4148, § B, left column, lines 1-2 and right column, lines 5-6 as used in equations 6a and 7a)**, c2) computing a phase related image (P.sub.j) of the object to be imaged from each group of basic images (R.sub.1, R.sub.2, . . . , R.sub.n; R.sub.2, R.sub.3, . . . , R.sub.n+1) **(page 4148, § B, equations 6a and 7a)** c3) averaging the computed phase related images (P.sub.1, P.sub.2) such that a phase related image (P) having a reduced amount of noise is formed **(page 4148, § C, lines 1-3)**, and c4) computing an image of the object to be imaged from the phase related image (P) having a reduced amount of noise **(i.e. Huang: Fig. 1, 3D image, after applying Joenathan's steps above)**.

Therefore it would have been obvious to one of ordinary skill in the art to have applied Joenathan's averaging steps to Huang's method, the motivation being to reduce noise due to errors or nonlinearities in the projection system **(Joenathan: page 4147, Introduction, lines 19-21)**.

Huang in combination with Joenathan does not explicitly recite the method as being for dental purposes, however this is taken by the Examiner as an intended use and is therefore not given patentable weight.

Regarding claim 2, Huang in combination with Joenathan, as applied to claim 1 above, teaches a method as defined in claim 1, wherein the computed phase related images (P.sub.1, P.sub.2) are averaged with weighting factors **(page 4148, § C, lines 1-3, i.e. weighting factors of ½ as understood by the common meaning of the term "average")**.

Regarding claim 3, Huang in combination with Joenathan, as applied to claim 1 above, teaches a method as defined in claim 1, wherein the basic images (R.sub.1 . . . , R.sub.m) are each recorded with a constant shift of the phase relation of the lattice (19) **(Joenathan: page 4148, § A, lines 2-3)**.

Regarding claim 4, Huang in combination with Joenathan, as applied to claim 1 above, teaches a method as defined in claim 1, wherein (n+1) basic images (R.sub.1, R.sub.2, . . . , R.sub.n+1) are recorded, successive basic images showing a phase shift, two groups of basic images (R.sub.1, R.sub.2, . . . , R.sub.n; R.sub.2, R.sub.3, . . . , R.sub.n+1) are formed **(page 4148, § B, left column, lines 1-2 and right column, lines 5-6 as used in equations 6a and 7a)**, a first phase related image (P.sub.1) is computed from the first group of basic images (R.sub.1, R.sub.2, . . . , R.sub.n) **(page 4148, § B, equation 6a)** and a second phase related image (P.sub.2) is computed from the second group of basic images (R.sub.2, R.sub.3 . . . , R.sub.n+1) **(page 4148, § B, equation 7a)**, and the first phase related image (P.sub.1) and the second phase related image (P.sub.2) are averaged, in order to

obtain a phase related image (P) having a reduced amount of noise, n being an integer at least equal to 3 **(page 4148, § C, lines 1-3, with n=3, i.e. 4 frames)**.

Regarding claim 6, Huang in combination with Joenathan, as applied to claim 4 above, teaches a method as defined in claim 4, wherein n is 4 **(page 4148, § A, i.e. 4-bucket method using equations 1 and 2 with 5 frames (n=4))**.

4. **Claim 5** is rejected under 35 U.S.C. 103(a) as being unpatentable over Huang combined with Joenathan as applied to claim 1 above, and further in view of Wilcock et al. (Hereinafter "Wilcock": A. H. Wilcock and R. L. G. Kirsner, "A Digital Filter for Biological Data", 1969, Pergamon Press, Med. & biol. Engng., Vol. 7, pp. 653-660).

Huang in combination with Joenathan, as applied to claim 1 above, teaches a method as defined in claim 1, wherein (n+2) basic images (R.sub.1, R.sub.2 . . . , R.sub.n+2) are recorded, of which successive basic images show a phase shift **(Joenathan: page 4148, Left column, lines 2-9, i.e. n=3)**.

Huang in combination with Joenathan does not teach the limitations wherein three groups of basic images (R.sub.1, R.sub.2, . . . , R.sub.n; R.sub.2, R.sub.3, . . . , R.sub.n+1; R.sub.3, R.sub.4, . . . , R.sub.n+2) are formed, a first phase related image (P1) is computed from the first group of basic images (R.sub.1, R.sub.2, . . . , R.sub.n), a second phase related image (P2) is computed from the second group of basic images (R.sub.2, R.sub.3, . . . , R.sub.n+1), and a third phase related image (P.sub.3) is computed from the third group of basic images (R.sub.3, R.sub.4, . . . , R.sub.n+2), and the first phase related image (P.sub.1) and the third phase related image (P.sub.3)

are averaged, in order to obtain an intermediate image (Pz), and the second phase related image (P.sub.2) and the intermediate image (Pz) are averaged, in order to obtain a phase related image (P) having a reduced amount of noise, n being an integer at least equal to 3.

However, Wilcock discloses a method for filtering data wherein a first phase related image (P.sub.1) and a third phase related image (P.sub.3) are averaged, in order to obtain an intermediate image (Pz), and a second phase related image (P.sub.2) and the intermediate image (Pz) are averaged, in order to obtain a phase related image (P) having a reduced amount of noise, n being an integer at least equal to 3 **(page 654, equation 2, i.e. with $A_{-1} = A_1 = ½$ as disclosed at the bottom of the left and top of the right columns)**.

Joenathan discloses the formation of two groups of basic images and corresponding phase related images as recited in claim 4 above. Therefore, in view of the disclosure of Wilcock above, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have formed a third group of basic images and a third corresponding phase related image in order to try the digital filtering method of Wilcock, the motivation being to reduce the amplitude of high frequency components in the data **(Wilcock: page 653, Introduction, lines 10-12)**.

5. **Claim 7** is rejected under 35 U.S.C. 103(a) as being unpatentable over Huang combined with Joenathan as applied to claim 1 above, and further in view of Windecker et al. (Hereinafter "Windecker": Robert Windecker and H. J. Tiziani, "Semispatial,

robust, and accurate phase evaluation algorithm", 1995, Optical Society of America, Vol. 34, No. 1, pp. 7321-7326).

Huang in combination with Joenathan, as applied to claim 1 above, teaches a method as defined in claim 1.

Huang in combination with Joenathan does not teach the limitation wherein the basic images (R.sub.1, . . . , R.sub.m) are recorded by an interlacing method so that the two fields are out-of-phase with each other.

However, Windecker teaches the limitation wherein the basic images (R.sub.1, . . , R.sub.m) are recorded by an interlacing method so that the two fields are out-of-phase with each other **(page 7325, right column, lines 12-16)**.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to have applied Windecker's interlacing method to the imaging method of Huang combined with Joenathan, the motivation being to reduce the data acquisition time **(Windecker: page 7325, right column, lines 23-25)**.

6. Claims 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huang combined with Joenathan and further combined with Windecker as applied to claim 7 above.

Regarding claim 8, Huang combined with Joenathan and Windecker teaches a method as defined in claim 7, wherein the two fields show a phase shift relative to each other which is equal to half the phase shift between successive basic images (R.sub.1, . . . , R.sub.m) **(Windecker: page 7325, right column, lines 16-19)**.

Regarding claim 9, Huang combined with Joenathan and Windecker teaches a method as defined in claim 7, wherein a phase related image (P.sub.1, P.sub.2) is computed from each of the fields of a basic image (R.sub.1, . . . , R.sub.m) **(Joenathan: page 4148, § B, equations 6a and 6B)** and the two phase related images (P.sub.1, P.sub.2) are averaged prior to further processing in such a manner that a phase related image (P) having a reduced amount of high-frequency noise is formed **(Joenathan: page 4148, § C, lines 1-3)**.

7. **Claim 10** is rejected under 35 U.S.C. 103(a) as being unpatentable over Huang combined with Joenathan as applied to claim 1 above, and further in view of Rubbert et al. (Hereinafter "Rubbert": US 6648640).

Huang in combination with Joenathan teaches a method as defined in claim 1.

Huang in combination with Joenathan does not teach the limitation, wherein prior to step a), an image of a specific test object is recorded and that on the basis of an analysis of the image of the test object a suitable scheme for use in the computation of the noise-reduced phase related image for the object to be imaged is selected.

However, Rubbert teaches a calibration method wherein prior to step a), an image of a specific test object is recorded and that on the basis of an analysis of the image of the test object a suitable scheme for use in the computation of the noise-reduced phase related image for the object to be imaged is selected **(Fig. 8 and column 9, lines 14-16)**.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to have applied Rubber's calibration method to the method of Huang combined with Joenathan, the motivation being to enable operation of the imaging system without precise knowledge of the optical and mechanical properties of the components **(Rubbert: column 9, lines 19-22)**.

8. Claims 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huang combined with Joenathan as applied to claim 1 above, and further in view of Brandestini et al. (Hereinafter "Brandestini": US 4837732).

Regarding claim 11, Huang combined with Joenathan teaches a method as defined in claim 1.

Huang combined with Joenathan does not teach the limitation wherein the object to be imaged and a camera used for recording the projected striped pattern can be freely positioned relative to each other.

However, Brandestini teaches a method wherein the object to be imaged and a camera used for recording the projected striped pattern can be freely positioned relative to each other **(Fig. 2)**.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to have made the object and the camera freely positioned relative to each other, the motivation being to allow a user to quickly make changes and verify results **(Brandestini: column 3, lines 6-8)**.

Regarding claim 12, Huang combined with Joenathan teaches a method as defined in claim 1.

Huang combined with Joenathan does not teach the limitation wherein an image of one or more teeth in an oral cavity of a patient is recorded by manual surveying over a short measurement period.

However, Brandestini teaches a method wherein an image of one or more teeth in an oral cavity of a patient is recorded by manual surveying over a short measurement period **(Fig. 1 and column 2, lines 34-36)**.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to have combined Brandestini's teaching with the method of Huang combined with Joenathan, the motivation being to allow a dentist to record the shape in situ of teeth prepared for repair **(Brandestini: Abstract, lines 1-2)**.

Regarding claim 13, Huang combined with Joenathan teaches a method as defined in claim 1, wherein the image to be created of said object is one of a relief image **(Huang: Fig. 3f)**.

Huang combined with Joenathan does not teach the limitation wherein the image to be created of said object is one of a contrast image.

However, Brandestini teaches a method wherein the image to be created of said object is one of a contrast image **(column 9, lines 24-26)**.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to have combined a contrast image with Huang's relief

image, the motivation being to improve the efficiency of the system **(Brandestini: column 7, lines 44-50)**.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Huang et al. (US6438272) discloses the use of phase shifting techniques for three-dimensional contouring. De Groot et al. (US 7068376) discloses the use of weighted averages of phase related images.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Clifton G. Daley whose telephone number is 571-270-3144. The examiner can normally be reached on Monday - Friday 7:30am - 4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Samir Ahmed can be reached on 571-272-7413. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Samir Ahmed
SPE
Art Unit 2624

CGD
9/24/2007

SAMIR AHMED
PRIMARY EXAMINER